

# **Attachment 1**

Nuvio Corporation, *Technical Considerations of E911 in Pure IP VoIP Networks* (2005)



## Technical Considerations of E911 in Pure IP VoIP Networks

Pure IP based VoIP networks like Nuvio Corporation's offer unique challenges for delivery of IP based emergency calls.

This document aims to outline the technical challenges of a service provider offering E911 emergency services in a pure IP based VoIP network.

### About Nuvio

Nuvio Corporation is a provider of VoIP services primarily to the small and medium sized business (SMB) market. A typical Nuvio customer is a small business with 2 to 50 employees located across 1-3 locations. Nuvio private labels its services to be sold under the brands of Internet service providers, network integrators, and VARs. Nuvio Corporation is headquartered in Kansas and employs 32 people.

### Nuvio's Network Architecture

#### Nuvio's Network is Pure IP

Unlike other VoIP providers, Nuvio does not maintain any time division multiplexing (TDM) based technologies on its network. From a customer's endpoint (e.g., an IP Telephone) until handoff to another carrier for termination, all Nuvio audio is transmitted and switched completely via IP. Accordingly Nuvio does not maintain native connections such as T1s, PRIs, or SS7 connectivity at any point to the traditional PSTN.

Nuvio's customers can make and receive calls from the PSTN based upon IP based services that Nuvio purchases from CLECs and IXC. Nuvio purchases from certain CLECs services that deliver incoming calls to certain DIDs via IP over the public Internet to Nuvio's servers which then in turn, deliver the calls based upon customer-selected call logic to the customer's IP endpoints. Similarly Nuvio delivers all outbound calls destined for the PSTN from Nuvio's customer's IP endpoint to an IXC via IP over the public Internet. Nuvio pays Interstate based access charges for all of these outgoing calls.

Through this entire call process, Nuvio is merely routing IP packets from one IP address to another IP address. All of these connections are taking place over the public Internet. Nuvio does not maintain, nor have access to any traditional elements of the telephone network. Nuvio is entirely dependant upon other providers for connectivity the PSTN.

## Nuvio does not control the customer's access method

Similarly, as Nuvio does not control any elements that connect directly to the PSTN, Nuvio does not control or maintain the customer's access method to Nuvio's servers. Nuvio customers maintain their own connections to the public Internet. They connect by a variety of technologies including Cable, DSL, traditional T1s, or next generation wireless.

The Nuvio network has no information about the customer's connection to the public Internet other than the IP address that the customer's connection is received from. Often times even this information does not reveal the true IP of the customer's IP endpoint due to technologies such as network access translation (NAT) or network firewalls.

Nuvio's customers can alter both their location and method of access to the public Internet with no notification to, or technical change observable by Nuvio's servers. Essentially all of Nuvio's customers devices are nomadic as they can be transported anywhere in the world with a connection to the public Internet and continue to function.

## E-911 Challenges

### Customer Location

Unlike a VoIP provider such as a cable or DSL provider that provides the last mile facility to the customer, Nuvio is in the business of provisioning service over third-party-provided broadband Internet connections. As such, Nuvio identifies its users by the serial number associated with their computing device and their IP address. In some instances, the IP address identified by Nuvio is not their "true" IP address due to certain technologies like NAT and firewalls described above. Because Nuvio does not provide the last mile facility, and access to Nuvio's servers is achieved over the public Internet, no company, including Nuvio, is able to determine the customer's physical location based solely on an IP address. Nuvio has addressed this problem by allowing customer's to provide and update their location information through a web-based portal. This method of determining a customer's location is entirely dependent on the customer proactively providing accurate information and keeping such information up-to-date. It is further limited by the frequency of database updates. For example, if a Nuvio customer utilizes their service from multiple addresses and provides Nuvio with updated address information, the location information available to PSAPs will be current only if the ALI database has also been updated prior to the emergency call. The frequency of database updates is entirely outside of Nuvio's control.

### Access to Emergency Network Elements

As Nuvio's network is purely IP based and does not maintain any traditional connectivity with the PSTN, Nuvio does not have any network elements that are technically capable of connecting to the selective routers in the traditional PSTN E911 architecture. Similarly as Nuvio is not a CLEC, there is no requirement for the ILECs to offer Nuvio connectivity to the selective routers. Finally, even if Nuvio could connect to selective routers controlled by ILECs, such a

solution would not work for portable VoIP services nor would it function with “virtual” telephone numbers.

## Nuvio’s Current Solution

Nuvio currently is able to provide E-911 services to customers that have telephone numbers located in 55% of the rate centers currently served by Nuvio. Nuvio is able to provide this service through a product sold by a CLEC that includes E-911 functionality. This service is currently only provided by a single CLEC that Nuvio purchases services from, and is not offered as a stand-alone product.

### Capabilities

Nuvio’s E-911 service today permits the delivery of some VoIP calls to the selective router infrastructure and availability of ALI information for those calls to the PSAPs. To a PSAP these calls would appear to have the same characteristics as other wireline calls.

### Limitations

Nuvio’s currently E-911 solution is limited in that :

- 1) It is not available when a customer address is in a different location than the NPA-NXX that is assigned to them.

Nuvio understands that the current selective router architecture is such that numbers from outside of the geographic area served by the selective router cannot be routed appropriately by the selective router.

- 2) It does not provide for businesses that may have one telephone number serving users in different locations.

The solution available from the CLEC is currently limited to providing one address or location per telephone number (TN), and thus if a business has several users at different locations using multiple IP addresses tied to a single telephone number, only one user’s location can be active at a time.

- 3) It is only available from one particular CLEC.

Although Nuvio has attempted to purchase similar services from other CLECs, Nuvio has not been able to buy such services from other CLECs.

- 4) It is not available as a standalone product, but rather is part of a bundle of inbound and outbound IP services from the CLEC.

The E911 service that is provided by the CLEC to Nuvio is part of a package of services that include inbound and outbound IP to PSTN services, and is not available for use with services

from other CLECs. This means that if Nuvio wanted to utilize the existing CLEC solution and assuming it was available in the particular service area, Nuvio would first have to terminate contracts it has with other CLECs, subjecting itself to early termination fees, and port all of its customers telephone numbers to the CLEC providing the VoIP E911 service.

5) It is only available in a subset of the rate centers served by the CLEC.

Although the CLEC is rapidly deploying the service, the CLEC has not yet activated the service across all of the rate centers that Nuvio purchases telephone numbers in.

6) The CLEC only serves a subset of the rate centers in the United States.

This is due to the footprint of the CLEC's network. Additionally the CLEC does not necessarily have the ability to access network elements from rural ILECs, as rural ILECs may not be required to interconnect with the CLEC.

## Future Solutions

A number of solutions have been advocated for solving the issue of letting VoIP calls into the E911 selective router infrastructure.

Some would require VoIP providers to negotiate and interconnect with every ILEC (RBOC or rural) for access to selective routers and the E911 system. Currently there exist no technical standards on the nature or scope of these interconnections. If such interconnection was based on dedicated legacy telecommunications facilities rather than the IP based communications over the public Internet, then service providers such as Nuvio that utilize 100% next generation IP based networks would be required to build out legacy TDM based telecommunications networks at a cost that would reach into the millions. Such networks would likely face all of the limitations of Nuvio's current E-911 system.

The resources required to deploy such TDM based networks is extensive. Vonage, a VoIP provider with TDM based interconnections with the PSTN (unlike Nuvio) has stated that it will spend \$10 million, and over \$1 million a month for such a system.<sup>1</sup> Even those who have made significant progress in such arrangements state that such an undertaking takes significant amounts of time and money.<sup>2</sup> It is also unclear what type of arrangements VoIP providers can obtain from incumbent LECs. While there has been many press reports concerning purported agreements between certain VoIP companies and incumbent LECs, there is no information concerning the details of such agreements nor is there any documentation available.

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<sup>1</sup> See comments of John Rego, CFO, Vonage at <http://www.redherring.com/Article.aspx?a=12028&hed=Vonage%3A+No+IPO+Plans#>

<sup>2</sup> See Vidal, Ron. How VoIP Technology Can Improve Public Safety. Telecommunications Magazine, September 2004 : "the process will take us more than a year and cost millions of dollars."

Nuvio's network is well suited for an immediate leap to the IP based delivery of E911 emergency calls. Most, if not all of the ILECs, now have the technological and network capability to receive telephone calls over the public Internet or can do so with minimal engineering effort. Assuming that appropriate technical standards were in place for call delivery and the associated protocols, a nationwide system to deliver IP based emergency calls to the appropriate ILECs via IP over the public Internet could be deployed with minimal resources. If the conversion from IP to TDM and delivery to the selective router took place at the ILEC level, then a nationwide system for the delivery of IP emergency calls could be deployed quickly and with a minimal amount of resource expenditure. Nuvio would, of course, pay for such functionality. Such a solution would avoid a patchwork of different methods for PSAPs to receive IP emergency calls, as well as not require immediate expenditures by PSAPs to upgrade their equipment to allow for the receipt of IP communications directly.

## Conclusion

Currently, technical limitations limit the usefulness of any solution for delivery of IP-based VoIP calls based upon interconnection using legacy telecommunications facilities. A system that is based upon an industry standard and IP-based interconnection of VoIP networks to the ILECs would allow native delivery of IP-based calls into the PSTN infrastructure without necessitating a resources intensive build out of legacy telecommunications facilities by pure IP service providers, nor an expensive nationwide upgrade of PSAPs to directly accept IP-based emergency calls.